THE
ATMOSPHERIC RESERVOIR
*Examining the Atmosphere and Atmospheric Resource Management*

# What makes hail?

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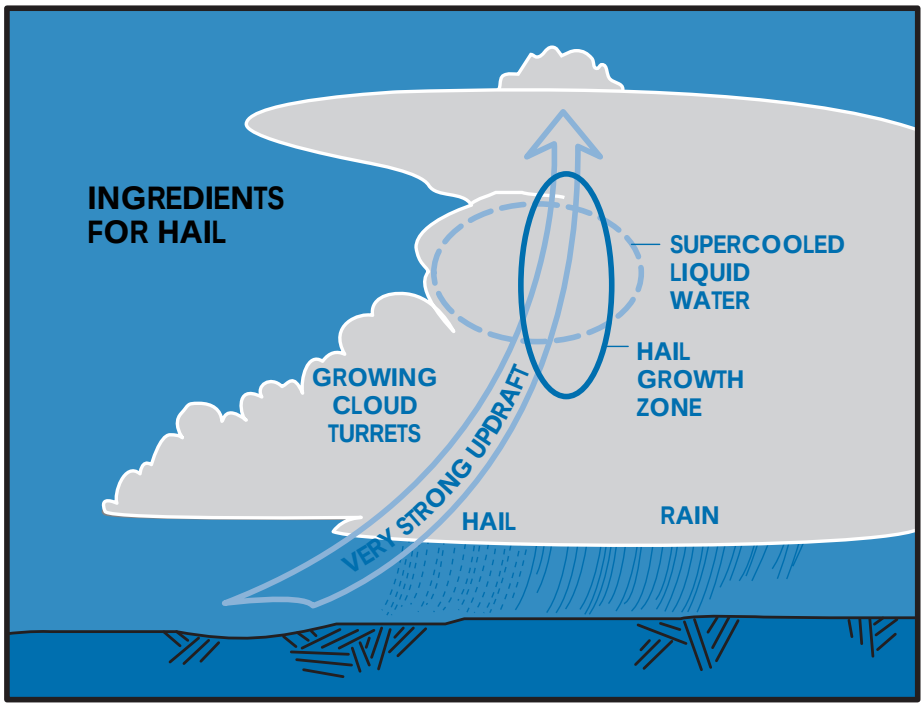


The *Glossary of Meteorology* defines hail as "precipitation in the form of balls or irregular lumps of ice, always produced by convective clouds, nearly always cumulonimbus." In lay-terms, this translates to "ice chunks produced by thunderstorms."

Hailstones are heavy. The fall speed of hailstones depends on the size. A one-inch stone will fall at nearly 40 mph, a two-inch stone at about 75 mph, and a three-inch monster at just over 100 mph. From this, we quickly realize that to grow to these sizes, the parent thunderstorm must possess very strong rising air currents, called *updrafts*. Without an updraft to support it within the cloud while it grows, the hailstone could never become very large.

Hailstones are produced when small ice particles, often frozen raindrops or snow pellets, encounter unfrozen liquid water at temperatures significantly less than 32°F. This *supercooled liquid water* (SLW) quickly freezes to the ice particle, resulting in the development of hail.

Large volumes of SLW frequently develop within taller, colder clouds, which do not begin to freeze until the cloud top grows high and cold, typically to about 0°F. When such vigorously-growing clouds are naturally slow to produce ice, they instead produce large amounts of SLW—the raw material from which hail is built.

When there are few small ice particles present within a cloud containing lots of SLW, ice particle growth is rapid. If the updrafts are strong enough, hail quickly develops.

Small hailstones usually melt during their final descent through the warm subcloud air, and reach the ground as rain. It is the large hail which doesn't melt completely that results in hail on the ground.

So, those thunderstorms that have strong updrafts, lots of SLW, and not much small ice are likely to be hailstorms. If the updrafts are weak or if there are lots of small ice particles, hail is not a threat.

Cloud seeding to suppress hail creates large numbers of small ice particles in areas where ice is slow to form naturally. These small particles compete with each other for the available SLW, quickly depleting it. Many small ice particles result, which mostly melt before reaching the surface.

The "seeding" of thunderstorms to accelerate ice production makes the cloud slightly more efficient, and increases the total rain volume while reducing the hail that reaches the ground. This is most recently documented as a 45 percent reduction in crop-hail damage within the western North Dakota target areas (*Journal of Applied Meteorology*, 1997). ■

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